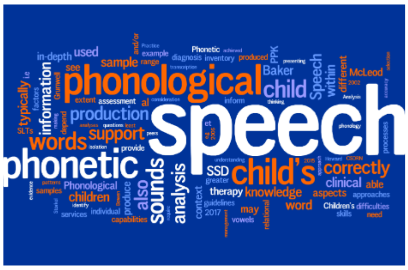
Good Practice Guidelines for the Analysis of Child Speech (2nd edition)



ROYAL COLLEGE OF SPEECH & LANGUAGE THERAPISTS

GOOD PRACTICE GUIDELINES

FOR THE ANALYSIS OF CHILD SPEECH (2nd edition)

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1: Introduction

1.1: Background

These guidelines have been developed by the UK and Ireland's Child Speech Disorder Research Network (CSDRN) to support Speech and Language Therapists (SLTs) in their analysis of disordered speech samples. They complement *The Good Practice Guidelines for Transcription of Children's Speech Samples in Clinical Practice and Research* (https://www.nbt.nhs.uk/sites/default/files/BSLTRU_Good%20practice%20guidelines_Transcription_2Ed_2017.pdf) (also developed by the CSDRN), which provide advice on the collection of speech samples and their phonetic transcription.

Phonetic transcription and phonological analysis of a speech sample are an integral part of the assessment process for children presenting with speech sound disorder and inform all aspects of clinical management (Bowen 2015, Howard and Heselwood 2002, McLeod and Baker 2014, McLeod and Baker 2017). For the purposes of these guidelines, the term Speech Sound Disorder (SSD) is used as an umbrella term to include all speech difficulties regardless of possible causative factors (see ASHA 2004b, McLeod *et al.* 2013). A speech sample that is representative and transcribed accurately is the first step towards diagnosis of potential SSD. Subsequently, careful consideration of the transcribed speech is fundamental to identify any issues with speech production and to place the child's speech abilities within the context of their typically developing peers. Synthesis of this analysis with findings from the child's case history ensures an appropriate differential diagnosis is reached and an individually tailored management plan drawn-up.

The CSDRN guidelines acknowledge the need for SLT services to clearly identify those children who require support with their speech development compared to those who do not. Importantly, commissioners need this type of relational, comparative information to justify provision of services. Currently, the only assessment standardised using speech samples from children in the UK and Ireland (and therefore suitable for this purpose), is the Diagnostic Evaluation of Articulation and Phonology (Dodd *at al.* 2006). However, SLTs can also refer to norm-based data on the ages of suppression of typical phonological processes combined with norms for speech sound acquisition to support their thinking (e.g., Grunwell 1987). Both these standardised and more informal norms-based approaches provide a valuable indication of service need and can also act as a baseline against which to monitor progress.

These guidelines recommend supplementing this relational information (formal or informal) with further phonetic and phonological analyses depending on the nature and severity of the child's difficulties and the clinical questions being addressed. For example, more in-depth analysis is recommended in the case of children with persisting speech difficulties at school-age and in moderate-to-severe and/or complex cases where there is evidence of atypical patterns, a major loss in contrastiveness and/or widespread variability in production (see Skahan *et al.* 2007).

A range of measures, tools and approaches exist to help the clinician capture independent factors unique to each child's presentation which may also include relational factors. Examples of tools that support phonetic/phonological analysis are: the Children's Independent and Relational Phonological Analysis (CHIRPA) (Baker 2016); the Phonetic and Phonological Systems Analysis (PPSA) (Bates and Watson 2012); the South Tyneside Assessment of Phonology 2 (STAP 2) (Armstrong and Ainley 2012); PACSTOYS (Grunwell and Harding 1995; and the Phonological Assessment of Children's Speech (PACS) (Grunwell 1985) (see McLeod and Baker (2017) and Bowen (2015) for a more in-depth discussion about different analytical approaches to SSD). Most importantly, whichever approach is favoured by individual SLTs and services, it must be able to capture phonetic and phonological aspects of the child's presenting SSD in sufficient depth to inform clinical decision making i.e., diagnosis of SSD, and selection of target/s and intervention approach. Phonological awareness and speech processing including auditory discrimination should also be routinely assessed.

The CSDRN guidelines describe these key aspects, highlighting when a more in-depth analysis is warranted and informing clinical thinking to support interpretation of findings. In addition, they provide a 'checklist' (see Appendix A) summarizing this information in an accessible manner, which may be used as a support when teaching students, auditing current practice, performing peer review or completing more in-depth analyses.

1.2: The importance of terminology – what is the difference between a child's phonetic inventory and productive phonological knowledge and why does this matter?

Speech development is two-fold, involving phonetic capabilities (potentially influenced by anatomical structure, hearing, articulatory and/or motor skills) on the one hand, and cognitive-linguistic phonological learning on the other (Ball and Müller 2011, Stoel-Gammon and Vogel Sosa 2014). Children failing to develop speech typically can present with difficulties in either one or both of these areas. Since children learn to recognise and produce sounds in words, the accuracy with which a given sound is produced will depend on a range of factors including the position it occupies within words (i.e., syllable-initial or final) and the adjacent phonetic context. For example, correct production of velar consonants may be facilitated in the context of back vowels and constrained in the context of front vowels. Critically, it will also depend on: the maturity of the child's speech processing skills at the time when they first learn/encounter a word; the information they are able to lay down in their long-term memory about its phonological properties; and the extent to which they are able to refine this information as they gain greater experience of the word and as their speech perception and production skills mature (see Stackhouse and Wells 1997). Factors such as word frequency, familiarity, and the number of words that share similar phonological patterns (e.g., <juice> [ʤus], <goose> [gus], <loose> [lus]) within a child's lexicon, all influence the accuracy with which speech sounds are produced in words (Storkel *et al.* 2006, Storkel and Morrissette 2002). It is important to note that the nature of this learning extends beyond single words to encompass the phonetic and phonological processes that enable fluent production of words in connected speech (Howard *et al.* 2008).

When assessing a child who is failing to develop speech typically, it is thus important to gather information on both their phonetic and phonological capabilities. Each of these can be measured in different ways and with a greater or lesser degree of detail. Throughout this document, particular notes of interest for clinical decision making will be highlighted by a red flag.

1.2.1: Phonetic Inventory

A phonetic inventory in its simplest form lists the speech sounds that a child can physically articulate irrespective of how he/she uses them in words. Thus, it will include speech sounds that are used both accurately and inaccurately when targeted by the child; for example, he/she may fail to produce target /s/, realising it as [t] 100% of the time but use [s] in place of target /ʃ/. This 'puzzle phenomenon' (Smith 1973) nicely illustrates the difference between phonetic and phonological knowledge.

Any speech sounds which have not been tested in the current sample are typically checked by asking the child to produce them in isolation to imitation.

A more detailed understanding of a child's phonetic capabilities <u>in relation to speech sounds not produced correctly</u> can be achieved by completing a stimulability assessment where his/her ability to produce speech sounds in isolation, and a range of syllable positions is investigated with clinician support and scaffolding e.g., Powell and Miccio's (1996) Stimulability Assessment.

1.2.2: Productive Phonological Knowledge

A *phonemic* inventory lists the speech sounds that a child is able to use <u>accurately</u> in their speech when targeted and provides a basic measure of their productive phonological knowledge (PPK). A child is judged to have PPK of a speech sound if it is used accurately when targeted at least once, within the speech sample. PPK can be further analysed along a scale ranging from no knowledge (the phoneme is never used accurately when targeted in words) to full knowledge (the phoneme is always used accurately when targeted within words) (Gierut *et al.* 1987). Detailed understanding of the extent to which individual phonemes are realised accurately when targeted across different word positions and phonetic contexts can usefully inform selection and prioritisation of therapy targets. For instance, there is evidence that for some children, greater system-wide generalisation may be achieved by targeting speech sounds for which they have least PPK (e.g., Gierut 1989, 2005, Gierut and Champion 2001).

In the following sections, we highlight the key questions of interest in a phonetic and phonological analysis of a phonetically transcribed speech sample. These relate to the child's production of vowels as well as consonants (singletons and clusters), word structures and connected speech. The extent to which these different aspects of speech production require consideration will of course depend on the child in question and their individual speech profile.

2. Recommended Process for Phonetic and Phonological Analysis

(See also the Checklist for Speech Analysis in Appendix A)

2.1 Inventories

2.1.1 Consonants

Is the consonant system complete? i.e., what phonemes are represented in the child's system and are there any gaps? NB. Check that 'missing' phonemes have actually been sampled:

(a) Are all <u>singleton consonants</u> present?

(b) Are a representative range of consonant clusters present? For instance, can the child produce clusters word-initially as well as word-finally? Can they produce obstruent + liquid clusters e.g., /bl/, /pɹ/? Can they produce /s/-clusters?

Where the child presents with a severely reduced phonetic inventory and subsequent widespread loss of contrast within the system, it may be more pertinent to take a wider-angled view and identify *emerging contrasts*. For example:

(a) Are all manner categories represented?
- plosives
- nasals
- fricatives
- Affricates
- Approximants

(b) Are all places of articulation represented?
- dental
- bilabial / labiodental
- alveolar
- post-alveolar
- palatal
- velar
- glottal

(c) Is there evidence of a voicing contrast?

A limited consonant inventory is considered a diagnostic indicator for moderate-to-severe phonological disorder and/or Childhood Apraxia of Speech (CAS)[1] (see Bowen 2015).

Age of acquisition of individual consonants can provide norm-based criteria against which to compare a child's speech development. For example, Shriberg's (1993) early-middle-late norms can support SLTs in identifying phonemes which may be particularly delayed and facilitate therapy target selection – early-8: / m, n, j, b, w, d, p, h/; middle-8: / t, ŋ, k, g, f, v, tʃ, dʒ/; late-8: / ʃ, ʒ, l, ɹ, s, z, θ, ð / + clusters. However, these should not be considered definitive and should always be used alongside norms for suppression of phonological processes, other standardised scores as appropriate, and information about the child's overall speech sound system. See Bowen (2015), Baker and McLeod (2017), and Rvachew and Brosseau-Lapré (2012) for further in-depth discussion.

2.1.2 Vowels

Is the vowel system complete? i.e., what phonemes are represented in the child's system and are there any gaps? NB. Check that 'missing' phonemes have actually been sampled:

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[1] The CSDRN has adopted use of the term Childhood Apraxia of Speech as opposed to Developmental Verbal Apraxia to conform with consensus use of this term internationally

(a) Are all corner vowels present, e.g., /i, a, ɑ, u/?[2]
(b) Are the mid-vowels present. e.g., /ɪ, ɛ, ɜ, ə, ʌ, ɒ, ɔ, o/?
(c) Are diphthongs present?

A limited vowel inventory may also indicate either phonological disorder and/or CAS (Pollock 2013, Pollock and Keiser 1990).

The vowel system is traditionally reported to be fully developed by 3;00 years (see Donegan 2002). Importantly however, more recent evidence suggests that vowels are not fully mastered in polysyllabic words and connected speech until much later (see James *et al.* 2001, Wren *et al*. 2012).

2.1.3 *Word Structures*

Is the word structure preserved?

(a) Is the child using CV structures?
(b) Is the child using CVC structures?
(c) Is the child using clusters (initial, inter-vocalic, final)?
(d) Is the child using disyllabic words (e.g., 'baby')
(e) Is the child using polysyllabic words (e.g., 'umbrella')

Difficulty in the production of polysyllabic words is a recognised area for alert in relation to more persistent phonological disorder and/or CAS (Masso *et al.* 2017).

2.2 Processes and patterns

2.2.1 What systemic (i.e., system-wide) patterns are evident in the sample? NB. These relate to difficulties contrasting speech sounds in terms of place and/or manner of articulation, and/or voicing. They therefore apply to natural classes of sounds, e.g., fronting of velar stops or backing of alveolar stops, stopping of fricatives and affricates, voicing of voiceless obstruents (i.e., fricatives, plosives, and affricates).

(a) What natural phonological processes (e.g., stopping) are present?
  - Which of these are delayed for the child's age?

(b) What atypical or idiosyncratic patterns (e.g., gliding of fricatives) are present?

The persistence of natural phonological processes beyond the expected age of suppression is associated with delayed phonological development. The presence of atypical and/or idiosyncratic processes indicates disordered development and/or CAS. Note that children can present with a mixed profile of both typical, i.e., delayed processes and atypical or 'deviant' patterns.

[2] The examples given here relate to the Southern British Standard English vowel system.

2.2.2 What evidence is there of variability in production and what are the patterns?

(a) For a given process/pattern, how many phonemes within the class are affected? For example, with stopping are all fricatives affected or a sub-set (e.g., /s, z, ʃ, ʒ/) only? Similarly, with final consonant deletion, are all classes of phoneme affected or certain classes only (e.g., final fricatives and affricates are deleted but plosives, nasals and liquids are realised)? Within any one class affected (e.g., fricatives) are all phonemes deleted or a sub-set (e.g., /f, v/) only?

(b) For any given phoneme which word/syllable positions are implicated? For example, velars may be fronted syllable initially, e.g., /ki/ → [t̠i], /geɪm/ → [deɪm] but produced correctly syllable finally, e.g., <sack> realised as [sak], <bag> realised as [bag].

(c) What evidence is there of context-conditioning? For example, velars may be fronted preceding non-low front vowels e.g., /ki/ → [t̠i], /geɪt/ → [deɪt] but produced correctly in the context of non-high back vowels /kɑ/ → [kɑ], /gəʊt/ → [gəʊt] (see Bates *et al.* 2013).

(d) What evidence is there of lexical conditioning? For example, later-acquired words may be produced correctly or more accurately than words acquired earlier, reflecting greater maturity in speech perception and/or speech motor skills (see Stackhouse and Wells, 1997).

This analysis allows the SLT to identify whether there is evidence of *progressive change* within the system, i.e., the fact that a phonological process or atypical pattern is not used universally within the sample is evidence that it is already moving towards suppression (Stoel-Gammon and Dunn 1985). It thus also provides another more detailed measure of the child's PPK and can usefully assist case prioritisation as well as inform selection of targets and therapy approach (see the worked case example in Appendix B). It is essential to distinguish this kind of progressive variability from widespread unexplained variability (Grunwell 1987) and inconsistent production of the same lexical item (token-to-token variability), e.g., /katəpɪlə/ produced as [tatəpɪlə], [tapəkɪlə], [takəpɪlə] (non-rhotic accent), to avoid potential misdiagnosis and selection of an inappropriate intervention approach.

Progressive variability is a positive prognostic indicator whereas non-progressive variability suggests more disordered phonological development and a greater need for intervention. Token-to-token variability is a diagnostic indicator of Inconsistent Phonological Disorder (IPD) (Dodd 2005) and is also associated with CAS (McLeod and Baker 2017).

2.2.3 What are the patterns of phoneme collapse? Systemic phoneme collapse (also referred to as use of a preferred sound or systematic sound preference, or multiple phoneme collapse) is where a single speech sound is used in place of several phonemes (see Williams 2000), e.g.,

/t/
/k/
[d] /l/
/ʃ/
/tʃ/

Identifying patterns of systemic phoneme collapse assists selection of therapy targets and approach, e.g., with multiple oppositions contrasting the substitution [j] with the targets it replaces /f, ʃ, tʃ, h/ (see worked case example in Appendix B).

2.2.4 What <u>word-level</u> error patterns are evident in the sample? NB. These include consonant harmony, sequencing errors and vowel or consonant insertion.

Consonant harmony (CH) is an assimilatory process, characteristic of early, typical development. It is a natural phonological process which reflects difficulty distinguishing sounds in terms of place or manner of articulation and/or voicing within specific <u>words</u>, e.g., <dog> /dɒg/ → [gɒg]. It is important not to mistake instances of CH as being examples of <u>systemic</u> patterns, e.g., backing, since this could lead to misdiagnosis, in this instance, phonological disorder. Sequencing errors and consonant/vowel insertions typically occur with greater frequency with increased processing demands, e.g., in longer, more articulatorily complex words and/or in connected speech and are associated with motor programming/planning difficulties.

2.2.5 What <u>phonetic level</u> errors (e.g., lateralised or dentalised sibilants, excessive nasalisation and lengthening of vowels) are evident in the sample?

Phonetic level errors, also referred to in the literature as articulatory errors, phonetic distortions or non-system sounds, relate to the mis-articulation or distorted production of individual sounds rather than a difficulty contrasting sounds in terms of voicing, place and/or manner of articulation. However, depending on the nature of the error, they can also result in a loss of phonological contrast (see Harding-Bell and Howard 2013). They may also occur alongside systemic patterns in the speech of children with CAS or phonological impairment. For instance, weakly articulated consonants (or 'lax') articulations such as the realisation of /p/ as the bilabial fricative [ɸ] are associated with CAS. Realisation of /tʃ, dʒ/ as [ts, dz] (non-system sounds in English) by children with phonological impairment can represent an intermediate stage between stopping of affricates (i.e., /tʃ, dʒ/ → [t, d]) and their correct production. (See also the following 'red flag' note on vowel distortions.)

It can be helpful to distinguish between articulation difficulties that are a secondary consequence of an anatomical, physiological, or neurological condition such as, for example, hearing impairment, cleft lip/palate, Cerebral Palsy or a neurodevelopmental condition (e.g., Down Syndrome), and primary difficulties which occur in the absence of any overt organic cause. Primary or unexplained difficulties are termed articulation disorder and form a restricted set which most typically involve the dentalisation or lateralisation of the sibilant fricatives /s, z, ʃ, ʒ/, realisation of /ɹ/ as [w] or [ʋ][3] and, in rhotic accent systems, de-rhoticisation of /ɚ, ɝ/. Secondary difficulties involve distorted production of potentially any phoneme, depending on the nature of the child's sensory/physical/neurodevelopmental condition and the extent to which this impacts the respiratory, phonatory, resonance and auditory as well articulatory speech systems (see McLeod and Baker, 2017 for a review).

[3] Note that production of /ɹ/ as [ʋ] is increasingly common among adult speakers of British English.

Systemic vowel error patterns such as vowel lowering e.g., <bed> /bɛd/ realised as [bad] or diphthong reduction e.g., <kite> /kaɪt/ realised as [kat] are associated with both phonological disorder and CAS (Pollock and Keiser 1990, Speake *et al.* 2012). Importantly, vowel distortions such as excessive vowel lengthening and use of non-system vowels are specifically associated with CAS (Pollock 2013.)

2.2.6 What factors contribute to poor intelligibility in the child's connected speech?
Compare the child's performance at single word versus connected speech levels to identify:

- Greater prevalence of patterns evident at the single word level reflecting the increased processing demands/lack of generalisation.
- Atypical juncture effects:
  - Open juncture i.e., **not** using typical connected speech processes to achieve fluid transition across word boundaries:
    - Assimilation, e.g., <red book> /ɹɛd/ + /bʊk/ → [ɹɛb°bʊk]
    - Elision, e.g., <soft bread> /sɒft/ + /bɹɛd/ → [sɒf bɹɛd]
    - Liaison (non-rhotic accents), e.g., <far> /fɑ/ but <far away> /fɑ/ + /əˈweɪ/ → [fɑɹ əˈweɪ]
    - Coalescence, e.g., <miss you> /mɪs/ + /ju/ → [mɪʃu]
    - Glide insertion, e.g., <blow out > /bləʊ/ + /aʊt/ → [bləʊʷaʊt]. (NB. Glide insertion is a natural coarticulatory pattern.)

The child may also separate words out from the speech stream through inappropriate use of pauses and glottal stops, also contributing to the perception of 'staccato-like' speech.

  - Close juncture i.e., over-use of segmental and syllable elisions and weakened articulatory realisations within utterances, e.g., <you can read my book> → [ju ʷãm wib˺maɪ bʊk], <I didn't even> → [aɪ jɪjɪn] (see Howard *et al.* 2008, Speake 2013, Wells 1994).

Atypical juncture effects disrupt speech fluency. In addition to highlighting prosodic disturbances (see also point 2.2.7 below), a connected speech assessment is necessary to identify difficulties achieving appropriate speech volume, pitch and voice quality that may be indicators of childhood dysarthria.

An inappropriate low speech volume, low pitch and harsh voice quality are characteristic features of childhood dysarthria.

2.2.7 What prosodic features is the child using successfully? Can they produce single words with the appropriate lexical stress, and is their prosody within utterances natural i.e., pausing, focal point of the sentence, emphasis etc. are all expressed appropriately?

Disruptions in prosody are a key diagnostic indicator of severe phonological disorder and/or CAS. ASHA (2007) highlights the importance of inappropriate prosody, particularly in relation to lexical or phrasal stress as being one of three diagnostic indicators of CAS (the other two being: inconsistency for repeated productions of the same word, and longer/disrupted co-articulatory transitions between segments and syllables).

Furthermore, persisting issues with the development of adult-like stress patterns in words such as frequent omission of weak syllables (particularly those in weak-strong patterns such as /bəˈlun/ → [ˈbun]) and strengthening of weak syllables i.e., underuse of schwa e.g., /dʒʌmpə/ → [dʒʌmpa]) may be indicative of issues at either the level of phonological representations and/or phonetic production.

Difficulty achieving appropriate speech rate and sentential stress is a diagnostic indicator of spastic dysarthria.

2.2.8 Percentage Consonants Correct (PCC) scores can provide a useful indication of severity and hence means of monitoring progress and measuring outcome. The Diagnostic Evaluation of Articulation and Phonology (Dodd *et al.* 2006) includes a standardised measure of PCC based on a single word (SW) sample. However, PCC scores can be calculated for *any* speech sample by calculating the number of tokens produced correctly and expressing this as a percentage of the total number of tokens produced (correct tokens ÷ total tokens x 100). See worked case example in Appendix B.

Percentage correct scores can also be extended to vowels, word structure and phonological processes. These values can be used as a baseline against which to compare progress in therapy. Indeed, for a child presenting with difficulties across both consonant and vowel systems, you may want to calculate the overall Percentage Phonemes Correct (PPC) score.

Most importantly, when using percentage correct scores make sure that the speech sample is representative and that all baseline comparisons are made against the same (or similarly distributed) sample[4]. For example, if 'Tom' is fronting velars word finally but not word initially it would be important to ensure that the initial assessment captures his pattern without bias i.e., targets velars equally across word initial and final positions. When collecting a post-intervention sample, the target stimuli must match the distribution of the pre-treatment sample i.e., in terms of the number of velar tokens both word-initially and finally to avoid either under- or over-estimating his progress in therapy.

It is important to note that PCC is a binary measure in that it only captures whether a phoneme is realised accurately when targeted or not. This adds to the importance of interpreting PCC with care as it will not always capture progression across time sensitively. For example, consider a child using consistent final consonant deletion where /kat/ → [ka] at initial assessment and then /kat/ → [kak] post-intervention. Despite the fact that final consonants are beginning to emerge post-intervention, this child receives the same PCC of 66.6% for each word produced. Credit is not given for the child's apparent progress because the post-intervention realisation is not completely accurate.

2.3 Further Assessment to Support Differential Diagnosis and Target Selection

Depending on the information provided by the analyses described above, the following supplementary assessments may be required to help support a differential diagnosis and selection of targets/intervention approach. The classification system adopted e.g., Dodd (1995, 2005), Shriberg *et al.* (2010) will dictate to some extent, the range of further assessments required (see Waring and Knight (2013) for a critique of different classification systems in SSD). A psycholinguistic framework such as the Stackhouse and Wells' (1997) model of single word processing may also be used to supplement clinical thinking in more severe and complex cases.

[4] Note that Shriberg's (1982) guidance on severity ratings for PCC is only relevant for samples of ≥200 utterances obtained from a conversational speech sample and for age ranges between 4;1-8;6 yrs. However, PCC scores may provide a useful informal independent baseline measure at SW level when considered within these limitations.

2.3.1 Stimulability Assessment

This is important as children presenting with non-stimulable sounds are less likely to show spontaneous improvement. There is also some evidence to support prioritisation of non-stimulable over stimulable sounds in intervention. This has been shown to result in greater system-wide change and more efficient (and hence ethical) use of clinician time (Gierut 1989, 2005, Gierut and Champion 2001, Powell *et al.* 1991). However, it is also important to note that with children under 4 years of age (and others not suited to this more complex approach, e.g., children with cleft palate related speech disorders) it may be more effective to target more stimulable sounds (Rvachew *et al.* 2001).

Stimulability is only assessed in the case of speech sounds for which the child has limited to no productive phonological knowledge (PPK) i.e., either not used in the child's system accurately when targeted, or used variably in only one syllable position (Gierut *et al.* 1987, Powell *et al.* 1991). Powell and Miccio's (1996) Stimulability Assessment is recommended, where a speech sound is considered to be stimulable if it is produced at least twice out of 10 opportunities.

2.3.2 Non-speech oro-motor assessment (examination of the oral cavity/articulatory oro-motor skills).

For children with moderate-to-severe SSD, it is important to rule out any potential structural or physiological deficits e.g., sub-mucous cleft palate or even an unrepaired overt cleft of the soft palate, velopharyngeal insufficiency and/or limited range and strength of muscle movements. Issues around the timing and co-ordination of articulatory gestures can be investigated using both real and non-words (e.g., diadokinetic rates (DDKs)). Importantly, DDKs can be sensitive to the type of difficulties more characteristic of children with CAS (Williams and Stackhouse 1998).

Assessment of oral structure and function is also important where childhood dysarthria is suspected. Indeed, it is important to differentiate dysarthria from CAS and/or an articulation disorder. A diagnosis of dysarthria requires observation of abnormalities in the strength, speed, range, steadiness, tone, or accuracy of movements required for breathing, phonatory, resonatory, articulatory, or prosodic aspects of speech production (Duffy, 2013, p. 4).

Robbins and Klees' (1987) Clinical Assessment of Oropharyngeal Motor Development in Young Children is an oromotor assessment protocol that can be replicated across children, time and settings (although their research included only 10 children per 6 month age band from 2;6-6;11 and therefore findings can only be used as guidance rather than norms).

2.3.3 Polysyllabic picture naming task (i.e., Deborah James' polysyllabic word list).

Polysyllable word production can be particularly sensitive to more serious SSD and is important to consider in a supplementary assessment. Indeed, child performance on polysyllables alongside an oromotor exam as noted above can provide vital information to support differential diagnosis of CAS vs speech difficulties caused by abnormal structure or dysarthria (Murray *et al.* 2015).

2.3.4 Inconsistency assessment (formal or informal).

This relates to the consistency of speech production for the *same* <u>word</u> across three repetitions as opposed to variable production of the same phoneme across different words (see section in 2.2.2). The DEAP (Dodd *et al.* 2006) includes a standardised inconsistency assessment within its battery where inconsistent production of 10 or more words out of the sample of 25, leads to a diagnosis of Inconsistent Phonological Disorder. However, an informal assessment may be easily developed following the same principles.

2.3.5 Psycholinguistic probes (e.g., real v non-word auditory discrimination, phonological awareness (e.g., phoneme segmentation and blending), real vs non-word repetition) (see Stackhouse and Wells 1997, 2007). These will help tease out the nature of the underlying deficit/s and guide appropriate weighting of input versus output tasks in intervention.

Children with persisting SSD often show multiple processing deficits (Speake 2013) and the psycholinguistic framework may help support further investigation of these.

2.3.6 Intelligibility assessment can make a valuable contribution to evaluation of a child's SSD (particularly when time is constrained in relation to gathering and analysing a connected speech sample). While there are a range of single word measures of intelligibility, these do not capture the functional impact of a child's SSD as comprehensively as measures considering connected speech. An example of an intelligibility measure considering connected speech is *The Intelligibility in Context Scale* (ICS) (McLeod *et al.* 2012b) which asks parents to rate the extent to which their child is understood by different people including themselves, immediate and extended family members, friends, other acquaintances, teachers and strangers on a five-point scale: 'Always, Usually, Sometimes, Rarely, Never'. See Baker and McLeod (2017, chapter 8, pp. 246-249) and Bowen (2015, chapter 2, p. 98) for further detail and discussion about assessment of intelligibility.

While intelligibility ratings can provide a useful indication of functional speech ability, it is important to recognise their subjective nature, i.e., different listeners are likely to make different judgements. They should, therefore, not be used as a sole measure of severity.

2.4 Measurement of Outcome (impact-based)

There is increasing emphasis on the use of impact-based outcome measurements alongside traditional measures focusing more on impairment and activity for both adults and children with speech, language, communication and swallowing needs. In view of this, assessment of moderate-to-severe speech disorder should also include a measure of functional outcome such as the *FOCUS: **F**ocus on the **O**utcomes of **C**ommunication **U**nder **S**ix (FOCUS©)* (Thomas-Stonell *et al.* 2009). The FOCUS has been validated as an outcome measure and considers the impact of SSD on the child's communication from the perspective of the International Classification of Function: Children and Youth Version (World Health Organisation 2007). Pre and post intervention baseline assessment on the FOCUS can be compared to identify whether significant improvement has been made in therapy.

Conclusion

These guidelines outline the key components of a phonetic and phonological analysis of phonetically transcribed speech data. They are not intended to be exhaustive or prescriptive but are designed to support clinicians in taking a systematic and principled approach to analysis and, where appropriate, a more in-depth contrastive analysis, supporting evidence-based practice[5].

[5] This document will be subject to ongoing revision as the evidence-base for SSD develops.

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These guidelines should be cited as follows:

Bates, S., and Titterington, J. with the Child Speech Disorder Research Network (2021) *Good practice guidelines for the analysis of child speech*. Published on RCSLT members webpage (www.rcslt.org) and Bristol Speech and Language Therapy Research Unit webpage (https://www.nbt.nhs.uk/bristol-speech-language-therapy-research-unit/bsltru-research/guidelines-relating-clinical)

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APPENDIX A

CHECKLIST FOR SPEECH ANALYSIS

NAME:	**DOB:**	**DATE:**

CONSONANTS

IDENTIFY PHONEMES FOR WHICH THE CHILD HAS LIMITED TO NO PRODUCTIVE PHONOLOGICAL KNOWLEDGE (PPK) AND NOTE THEM BELOW: -

Phonemes the child never uses accurately (no productive phonological knowledge exhibited):

Phonemes the child uses accurately only once in one syllable position (limited productive phonological knowledge):

Phonemes not tested:

Onset clusters (#correct/#assessed):

SUPPLEMENTARY STIMULABILITY ASSESSMENT FOR PHONES WITH LIMITED TO NO PRODUCTIVE PHONOLOGICAL KNOWLEDGE (list those that are stimulable and not stimulable):	**STIMULABLE**	**NOT STIMULABLE**

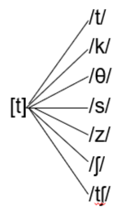
Optional: PCC (correct singletons/total singletons x 100 = %) = **% onset clusters correct =** **% final clusters correct =**

List phonetic level errors e.g., dentalisation, lateralisation:

Patterns and Processes (with age of suppression if known, in parentheses (Grunwell, 1987) and highlighted in grey (Dodd et al., 2002)

Typical/Atypical Phonological Processes/Patterns	**Redup (2;0)**	**WSD (2;0-3;11)**	**FCD (-2;0)**	**h-del**	**Cl. Red (2;0-4;11)**	**CH (4;0)**	**Voice (2;0-2;11)**	**Devoice (3;0)**
Tick or make a tally count for all patterns evident.	**Pal front (3;9)**	**Vel front (2;0-3;11)**	**Stopping /f,s/=3;0, /v,z/=3;6 /ʃ,tʃ,dʒ/=4;6**	**Stopping of Affric (4;6)**	**Glide approx. 5;0 /ɹ/ ≥ 6;0**	**Vocalisation of word final /ɹ/ or /r/ (rhotic accents)**	**l-voc (2;0)**	**Deaffric (2;0-4;11)**

			/θ,ð/=5;0					
	Diph Red	**Diphisation**	**Vowel lowering**	**Vowel raising**	**Vowel fronting**	**Vowel backing**	**Fricative Simp**	**Backing**
	Glottal replacement	**Lin. features**	**Glidefric**	**Systematic Phoneme Collapse**	**ICD**	**Coal. features**		
	Other:							
	Delay apparent (✔ / ✕): **Range of delay apparent (i.e., 6-37 months):** **Atypical patterns apparent (✔ / ✕):** **Youngest age of acquisition for phonemes with no PPK (never used correctly) (McLeod and Crowe 2018):** **Note any positional constraints e.g., velar fronting only in word initial position:** **List the key dominant and most consistent patterns (where available add age of suppression and note any that are atypical):**							
Systems of phoneme collapse for typical and atypical processes e.g.,	**Extensive phoneme collapse apparent (✔ / ✕):** **Identify preferred substitution/s for the most prevalent patterns:**							

	
Variability	**Progressive variability (✔ /✕):** **Context Conditioning (✔ /✕):** **Widespread unexplained variability (✔ /✕):** **Note any exceptions from general patterns for specific phonemes i.e., one example of stopping in a predominant pattern of gliding of fricatives:** **Supplementary assessment: Token-to-token variability/variability across multiple repetitions of the same word i.e., lexical inconsistency (✔ /✕/N/A):**
Non-system-wide, word level errors	**Present (✔ /✕):** **List types of errors i.e., metathesis, transposition, sequencing errors, vowel and/or consonant insertion:**
Connected Speech Patterns	**See separate analysis sheet**
OVERALL INTELLIGIBILITY RATING/RATING OF IMPACT	**Assessment, date and findings i.e., Intelligibility in Context Scale (McLeod, Harrison et al. 2012):**

<table>
<tr>
<td rowspan="2">Oro-motor Examination
(comment as appropriate)

May map to standardised assessment scores</td>
<td>Structure (ensure soft and hard palate are intact):</td>
<td>Function:</td>
<td>DDK rates:</td>
</tr>
<tr>
<td colspan="3">Where differential diagnosis is required between possible CAS, dysarthria or articulation difficulties note observations of any abnormalities in strength, speed, range, steadiness, tone and/or accuracy of movements required for aspects of speech production including (Duffy 2013, p. 4):

Breathing Phonation Resonance Articulation Prosody</td>
</tr>
<tr>
<td>Phonological Awareness Skills
Informal/Formal/Not applicable</td>
<td colspan="3"></td>
</tr>
<tr>
<td>Speech/Auditory Discrimination Scores
Informal/Formal/Not applicable</td>
<td colspan="3"></td>
</tr>
<tr>
<td>Standardised Scores on Phonological/Articulation Assessment (if applicable)</td>
<td colspan="3"></td>
</tr>
<tr>
<td colspan="4">ALERTS/WARNING SIGNS FOR DISORDER/PERSISTENT SSD/CAS
(circle/highlight all that apply)</td>
</tr>
<tr>
<td>SSD alerts
(circle all that apply)</td>
<td colspan="3">Characteristics of Phonological Disorder (Stoel-Gammon and Dunn 1985):
• Delayed development of phonological processes from early-on i.e., persistence of natural phonological processes which typically resolve by 2;0-2;6 years</td>
</tr>
</table>

	• **Notable variability (non-progressive inexplicable variability (not progressive variability or context-conditioning)** • **Use of later acquired sounds alongside persistent errors of earlier acquired sounds** • **Atypical patterns** • **Limited contrastiveness** • **Speech sound system that has become fixed at an earlier stage of phonological development** ***Characteristics of Childhood Apraxia of Speech*** **Note key features which <u>must</u> be present for CAS diagnosis re ASHA (2007):** • **Inconsistency on multiple repetitions of probed words <u>plus</u>** • **Difficulty with co-articulatory transitions between segments and syllables** • **Prosody that is inappropriate e.g., marking typical lexical and phrasal stress patterns** ***Consider also features of Childhood Apraxia of Speech by Strand (Shriberg et al. (2012) table II, p. 453):*** • **“Vowel distortions (NB. These refer to phonetic errors such as abnormal vowel lengthening as opposed to systematic vowel error patterns such as vowel lowering or backing. The latter may be present but can also features of phonological disorder.)** • **Voicing errors** • **Distorted substitutions** • **Difficulty achieving initial articulatory configurations or transitionary movement gestures** • **Groping** • **Intrusive schwa** • **Increased difficulty with multisyllabic words** • **Syllable segregation** • **Slow rate** • **Slow diadochokinetic rates** • **Equal stress or lexical stress errors”** **A child must have vowel distortions and at least 3 of the other errors across 3 different types of speech task in order to be differentially diagnosed with CAS.**

	Additional alerts for persistent SSD from Bowen (2015): • **Glottal stops used when not dialectal (excessive and not explained by context-conditioning) (commonly associated with cleft palate/VPD, and also commonly reported as a characteristic of CAS by some sources *(Namasivayam et al. 2015))*** • **Initial consonant deletion (found typically in some languages)** • **Small phonetic inventory** • **Alveolar backing (particularly associated with OME and/or cleft palate/VPD)** • **Vowel errors (prevalent or inconsistent suggest CAS but can also be apparent in phonological disorder)** • **Persistent FCD when 3 years +** • **Conversational PCC < 50% at ~ 5;6 (Shriberg and Kwiatkowski 1982)**
CONSIDER ALL DATA AND ANALYSES IN LIGHT OF CHILD'S CHRONOLOGICAL AGE, AND INDEPTH CASE HISTORY INFORMATION TO SUPPORT DIAGNOSTIC THINKING	

• ***Alerts for speech sound disorder (Bowen 2015, box 2.2, p. 81):***
  • ***Late onset or no babbling***
  • ***Hearing history: Otitis media with effusion > referral for hearing screening***
  • ***Critical age hypothesis – need to be intelligible by 5;6 yrs re literacy etc.***
  • ***Developmental delay/Intellectual disability – SSDs more likely; deletion of Cs most frequent error; inconsistent errors; pattern of delay***
• ***Alerts for persistent SSD (Eadie et al. 2015, Wren et al. 2016):***
  • ***Family history of SSD***
  • ***Gender – being male***
  • ***SES – lower SES***
  Early Childhood:
  • ***Early feeding history - weak suck***
  • ***Words not combined at 24 months***
  • ***Limited use of morphology at 38 months***
  • ***Unintelligible to strangers at 38 months***
  • ***Speech and motor difficulties at 24 months sensitive to risk of SSD at 48 months***
  School-age:
  • ***Hearing impairment at 7 years (> 20dBHL)***
  • ***History of vent insertion up to 8 years***	

• ***Parental report of difficulty with pronunciation at 7 years*** • ***Poor nonword repetition*** • ***Suspected difficulties with motor co-ordination***	
DIAGNOSIS AND SEVERITY (These classifications relate to primary SSD and are derived from Dodd (1995, 2005)) **Circle as appropriate**	**Phonological Delay (uses typical phonological processes but delayed for age)** **Consistent Phonological Disorder (systematic use of atypical/deviant patterns in addition to typical phonological processes)** **Articulation Disorder (phonetic level errors which may or may not result in a loss of contrast)** **Inconsistent Phonological Disorder (high degree of token-to-token variability without associated oro-motor deficits)** **Childhood Apraxia of Speech (see classification above)** **Dysarthria** **NB. Children may also present with a mixed profile.** **<u>Severity:</u>** **Mild Moderate Severe**

Key to phonological processes/patterns and atypical patterns:

Redup – reduplication; WSD – weak syllable deletion; FCD – final consonant deletion; h-Del - h-deletion; Cl. Red - cluster reduction; Diph Red - diphthong reduction; Diphisation – diphthongisation; Voice – voicing; Devoice – devoicing; Pal front - palatal fronting; Vel front - velar fronting; Stopping of Affric – stopping of affricates; Deaffric - deaffrication; Glide approx. – gliding of approximants; l-voc - l-vocalisation; VPD - Velopharyngeal dysfunction; Glottal replacement (if not dialectal and/or context appropriate); Backing - alveolar backing; Glidefric – gliding of fricatives; systemic phoneme collapse - systematic sound preference/phoneme collapse; ICD - initial consonant deletion; Coal. features - coalescence of features; Lin. features - linearization of features.

SOUTHERN BRITISH STANDARD	
VOWELS (SBS SYSTEM)	
PHONETIC INVENTORY (tick if phones are present at all in the child's system (even if used incorrectly))	
CORNER VOWELS	i a ɑ u
MID-VOWELS	ɪ ɛ ɜ ə ʌ ɒ ɔ ʊ
DIPHTHONGS	Closing (rising from open to closed) eɪ aɪ au ɔɪ əu Centring (ending in schwa) iə ɛə uə
PRODUCTIVE PHONOLOGICAL KNOWLEDGE (circle phones used correctly at least once in the sample and highlight gaps)	
i a ɑ u ɪ ɛ ɜ ə ʌ ɒ ɔ ʊ eɪ aɪ au ɔɪ əu iə ɛə uə	
Optional: Percentage Vowels Correct (correct vowels/total vowels x 100 = %) =	

SCOTTISH	
VOWELS	
PHONETIC INVENTORY (tick if phones are present at all in the child's system (even if used incorrectly))	
CORNER VOWELS	i a o
MID-VOWELS	ɪ e ɛ ə ʌ ʉ ɔ
DIPHTHONGS	Closing (rising from open to closed) ʌi ɑːe ʌʉ ɔə
PRODUCTIVE PHONOLOGICAL KNOWLEDGE (circle phones used correctly at least once in the sample and highlight gaps)	
i a o ɪ e ɛ ə ʌ ʉ ɔ ʌi ɑːe ʌʉ ɔə	
Optional: Percentage Vowels Correct (correct vowels/total vowels x 100 = %) =	

ULSTER	
VOWELS	
PHONETIC INVENTORY (tick if phones are present at all in the child's system (even if used incorrectly))	
CORNER VOWELS	i a ɑ/ ɒ ʉ
MID-VOWELS	ɪ ɛ ɜ ə ʌ ɔ o
DIPHTHONGS	**Closing (rising from open to closed)** **Centring (ending in schwa)**
PRODUCTIVE PHONOLOGICAL KNOWLEDGE (circle phones used correctly at least once in the sample and highlight gaps)	
i a ɑ ɒ ʉ ɪ ɛ ɜ ə ʌ ɔ o ɛə iə ʉə oə ɔə ai ei ɔi ɒʉ	
Optional: Percentage Vowels Correct (correct vowels/total vowels x 100 = %) =	

WORD STRUCTURE	
INVENTORY OF WORD STRUCTURES (tick structures present (even if not correct) and circle those that are only used correctly)	
Monosyllables	**CV VC CVC CCVC CVCC CCVCC**
Disyllables	**CVCV CVCVC CCVCVC CVCCVC CVCVCC OTHER (provide structures):**
Multisyllables	**CVCVCV CVCVCVC CCVCVCV CCVCVCVC OTHER (provide structures):**
Clusters Used	**Initial Clusters consistent (✔ /✖):** **Final Clusters consistent (✔ /✖):** **Medial clusters (attempts to use more than one consonant within syllable boundaries):**
Optional: Percentage word structure used correctly (correct word structure/total word structures x 100 = %) =	
Summary:	

Connected Speech Analysis and observation of prosody	
Circle/highlight if and as appropriate	
Greater use of patterns than noted at single word level	**Yes No**
Presence of open juncture:	**1. Non-use of typical connected speech processes** **2. Inappropriate use of pauses/glottal stops between words**
Presence of close juncture:	**1. Overuse of segmental/syllable elisions** **2. Weakened articulatory realisations**
Additional Prosodic disruptions	**1. Lexical stress appropriate/not appropriate e.g., /ˈmʌmɪ/ > [ˈmʌˈmɪ]** **2. Sentence level stress appropriate/not appropriate e.g., focus, attitude, grammar etc are expressed meaningfully.**
Additional comments (further detail on observations as appropriate e.g., child is using syllable-timed speech):	

APPENDIX B

Stanley (5;6 yrs): a worked example

In this section we include a worked example (Stanley, 5;6 yrs) to illustrate the benefits afforded by taking a contrastive analysis approach in more severe/complex cases of SSD. This is based on a single-word speech sample elicited using the diagnostic screen and phonology sub-test of the Diagnostic Evaluation of Articulation and Phonology (DEAP) (Dodd *et al.* 2006). Stanley's responses were phonetically transcribed, and the data was then charted on the PPSA (Phonetic and Phonological Systems Analysis) (Bates and Watson 2012). Please note that while the PPSA was used for this analysis, the same information can be obtained from different tools/measures (e.g., see point 1.1, page 2).

The transcription data are shown below with kind permission from Pearson Publications (October, 2017). Unfortunately, due to copyright restrictions, we are unable to reproduce the DEAP target stimuli. The reader must have access to the DEAP assessment forms in order to make a direct comparison between Stanley's realisations and the adult target forms. Despite this, we hope that the reader will be able to gain an appreciation of the nature and extent of Stanley's speech difficulties from the completed PPSA and see how the information provided by this type of analysis can assist clinical decision making. After initial analysis on the PPSA, findings have been synthesized using the Checklist for Speech Analysis provided in Appendix A. To assist interpretation, we give a summary of the key points arising from the analysis and discuss their implications for Stanley's differential diagnosis and our choice of intervention approach and targets.

<u>Data Used:</u> Diagnostic Evaluation of Articulation and Phonology (Dodd *et al.* 2006) – Diagnostic Screen and Phonology Assessment (all items). Accent System: Southern British Standard

Stanley's Realisations (phonetic)		
[wɒ]	[wɒ]	[jaɪ]
[jɪjɪn]	[jɪjɪn]	[di]
[gʌ]	[gʌ]	[wɒ]
[baɪbə]	[baɪbə]	[jɒjɪn]
[janju]	[janju]	[gul]
[jɪjə]	[jɪjə]	[bab]
[jɛjɪʔɒbə]	[jɛjɪʔɒbə]	[bɪʔɪ]
[bɪ]	[bɪ]	[janju]
[jʌmbɛjə]	[jʌmbɛjə]	[jɛjɪʔɒbə]
[jɛjɪjənt]	[jɛjɪjənt]	[jɛ]
[jɛjɪjənt]		[ba]
[jʌmbɛjə]		[dɛə]
[deɪn]		[bɪ]
[wɪn]		[gʌ]

[bɛ]	[din]
[dʌʔ]	[ji]
[dəjɑ]	[jɒ]
[jɛjəʊ]	[jɒjɪ]
[bɔbi]	[daɪdə]
[baɪbə]	[wabɪ]
[bɛb]	[bʊk]
[jip]	[bɔɪ]
[neɪk]	
[bam]	
[jɛjə]	
[mɑdəʊ]	
[mʌndi]	
[bubʌ]	
[jabəl]	
[naɪ]	
[jan]	
[jiə]	
[jɪs]	
[jɪjə]	
[jɪjɪn]	
[jaɪjaʊ]	
[jɛbə]	
[dɪʔən]	

PPSA Quick Guide

The PPSA consonant singleton chart (page 1) has three main sections: **Correct Realisation**, **Errored Realisation** and **Deletion**. Each of these is further sub-divided into three columns indicating the position of the target sound in the word: **WI** (word-initial), **WM** (word-medial) and **WF** (word-final). To illustrate how we use these columns, consider the following data: /pai/ and /pɪp/ realised as [pai] and [ɪb] respectively.

PI	Target	Correct Realisation			Errored Realisation			Deletion			Place	Manner
		WI	WM	WF	WI	WM	WF	WI	WM	WF		
✓	p	1 -		-			b	1			Front	Oral Stop
✓	b											

Correct realisation of /p/ in /pai/ is indicated by placing a tally mark (the numeral 1 or a vertical line) in the WI column next to **Target** p. We also tick the **PI** column to indicate that [p] is part of the child's phonetic inventory. In /pɪp/ the initial /p/ has been deleted. In this case, we place a dash in the WI Correct Realisation column to show that the child has been given another opportunity to produce /p/ word-initially but on this occasion has failed to realise it correctly. A tally mark is then also noted in the WI Deletion column. Realisation of /p/ as [b] word-finally is noted by first placing a dash in the WF Correct Realisation column to record that /p/ has been tested in this position but realised incorrectly. The actual errored pronunciation [b] is then also chartered in the WF Errored Realisation column. 'b' also receives a tick in the PI column to indicate that it is within the child's phonetic inventory even though, in this sample, it has been used to realise target /p/.

The cluster table (page 2 of the PPSA) lists common consonant clusters found word-initially and word-finally in English. Space is left for the clinician to note any word-medial 'clusters' evident in the sample. These are defined as any sequence of two or more consonants occurring within a word (i.e., between two vowels) as, for example, /sk/ in 'basket'. Clusters realised correctly are marked with a tick beside the target. Where clusters are realised incorrectly, the errored production is written beside the target.

The Error Pattern Summary lists the most common natural phonological processes and atypical speech patterns found in children with SSD. These are grouped according to whether they are systemic structural or segmental patterns, word-level patterns, or phonetic errors. Atypical patterns are shaded. The clinician can record which of these are evident in the data by simply placing a tick in the box alongside the relevant heading.

NB. In Stanley's PPSA analysis we have noted the occurrence of word-level error patterns such as consonant insertion (e.g., /ɛg/ → [jɛg]) in the 'Other Errors' box at the bottom of page 1 together with instances of weak syllable deletion and reduplication, patterns which cannot be charted in the same way as systemic processes/patterns involving phoneme substitutions or omissions. We have also noted instances of consonant harmony (CH), another word level error pattern, in the 'Other Errors' box. As CH is an assimilatory pattern involving phonetic feature changes at the phoneme level, it is possible to chart this data and, indeed, this can usefully serve to distinguish instances of CH from other systemic processes/patterns (see point 2.2.4, page 6 for further discussion). In Stanley's PPSA, words containing instances of CH have been charted in blue.

For further information about how to use the PPSA, please see the PPSA User Guide at https://www.nbt.nhs.uk/bristol-speech-language-therapy-research-unit/bsltru-research/child-speech-disorder-research-network

Phonetic and Phonological Systems Analysis-English Systems (PPSA). Target accent: SBS

Name: Stanley Date/Age:/5;6 Data used: DEAP screen + Phonology Assessment

PI	Target	Correct Realisation			Errored Realisation			Deletion			Place	Manner
		WI	WM	WF	WI	WM	WF	WI	WM	WF		
✔	p	—	—	I	b	b					Front→Back	Oral Stops/Plosives
✔	b	III	II	II		b						
✔	t	≡		—	d b d					I		
✔	d	I	≡	—		bbb				I		
✔	k	—	≡	II —	d	ʔʔʔ	ʔ					
✔	g		—	≡		d				III		
✔	m	I		I							Front→Back	Nasals
✔	n	I		IIII								
	ŋ			≣			nnnn					
	f	≢	≡	=	jjjjj	jjj				III	Front→Back	Fricatives
	v	—			j							
	θ	≡		—	jj					I		
	đ	—	—		j	j						
✔	s	≣	—	I —	jjjj	j				II		
	z	—	≡	≡	j	jjj	jj			I		
	ʃ	—	≡	=	j	jjj				II		
	ʒ											
	h	≡			jjj							
	ʧ		—	≡		ʔ				III		Affricates
	ʤ	—		=	d					II		
✔	w	III —			b						Front→Back	Approximants
	ɹ	—	=		w	jj						
✔	l	—	≢ ≡	II	j	jjjjjjjj						
✔	j	I										
	ɹ										Rhotic	

Other Errors (eg sequencing errors, consonant harmony)

THESE ARE ANALYSED ON THE SINGLETON AND CLUSTER TABLES IN BLUE:

[ˈbaɪbə] x 3 (CH), [bab] (CH), [ˈbɔbi] (CH and weak syllable deletion), [bɐb] (CH) [ˈbubʌ] (redup); [jʌmˈbɛjə] x 3, [ˈjɛjɪˈʔɒbə] x 3, [ˈjɛjɪˈjənt] x 3, [ˈjɒjɪn], [jɛ], [ˈjabəl], [jiə] (consonant insertion); [ˈmadəʊ] (weak syllable deletion) (Note that instances of consonant insertion and weak syllable deletion are not analysed above)

Phonetic and Phonological Systems Analysis-English Systems (PPSA). Target accent:SBS

Name: Stanley Date/Age /5;6 Data used: DEAP Screen + Phonology Ax

Word Initial		Word Medial	Word Final	
pl-	fl-	-ŋkj- nj nj nj	-mp	-ks
pɹ- b	fɹ- j	-pt- b b b	-nt nt nt nt	-gz
bl-	θɹ- j	-mbɹ- mb mb mb	-nd	-pt
bɹ- bb	sp- b b b	-sk- ʔ	-ŋk	-bd
tw-	sm-	-ŋk- nd	-ft	-kt
tɹ- d	sw- w	-θbɹ- b	-sp	-ɹp^{R}
dw-	st-	-th- j	-st	-ɹb^{R}
dɹ-	sn- n	-bɹ- b	-sk	-vz ∅ ∅∅
kw- d	sl-		-lp	-ndʒ- n
kl-	sk- g		-lt	
kɹ- b	spl- b		-lk	
gl- g g g	spɹ-		-ps	
gɹ-	stɹ- b		-bz	
	skw- d		-ts ∅	
	skɹ-		-dz	

Error Pattern Summary (shading denotes atypical error patterns)

Structural	**(✓)**	**Segmental**	**(✓)**	**Phonetic/Other**	**(✓)**
Reduplication	✔	Pre-vocalic voicing	✔	Dentalisation	
Weak syllable deletion	✔	Post-vocalic devoicing		Lateralisation	
Final C deletion	✔	Palatal fronting		Palatalisation	
Initial C deletion		Velar fronting	✔	Ingressive air stream	
h-deletion		Alveolar backing		Nasal emission	
Consonant insertion	✔	Stopping		Clicks	
Vowel insertion (epenthesis)		Spirantisation / Frication			
Cluster reduction	✔	Deaffrication	✔		
Diphthong reduction		Gliding of fricatives	✔		
Diphthongisation		Gliding of approximants	✔		
Coalescence of features		Glottal replacement	✔		
Linearisation of features		Systematic sound preference	✔		
Word level errors		l-vocalisation		**Variability / Further ax required?**	**(✓)**
Consonant harmony	✔	Vowel lowering		Progressive variability	✔
Transposition (metathesis)		Vowel raising		Context-conditioning	
Sequencing errors		Vowel fronting		Inconsistent production of same lexical items	
		Vowel backing		Multi-lingual influence	

Completed Checklist for Speech Analysis Example

(analysis in red font)

NAME: Stanley	**DOB:** 5;6 yrs	**DATE:**

CONSONANTS

IDENTIFY PHONEMES FOR WHICH THE CHILD HAS LIMITED TO NO PRODUCTIVE PHONOLOGICAL KNOWLEDGE (PPK) AND NOTE THEM BELOW: -

Phonemes the child never uses accurately (no productive phonological knowledge exhibited): /ŋ, f, v, θ, ð, z, ʃ, h, ʧ, ʤ, ɹ/

Phonemes the child uses accurately only once in one syllable position (limited productive phonological knowledge): /p, d, s, j/

Phonemes not tested: /ʒ/

Onset clusters (#correct/#assessed): 0/20 (see PPSA for specific clusters targeted)

SUPPLEMENTARY STIMULABILITY ASSESSMENT FOR PHONES WITH LIMITED TO NO PRODUCTIVE PHONOLOGICAL KNOWLEDGE (list those that are stimulable and not stimulable):	STIMULABLE	NOT STIMULABLE

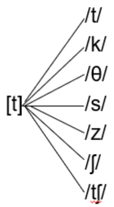
Optional: PCC (correct singletons/total singletons x 100 = %) = 26/107x100=24% **% onset clusters correct =** 0% **% final clusters correct =** 38%

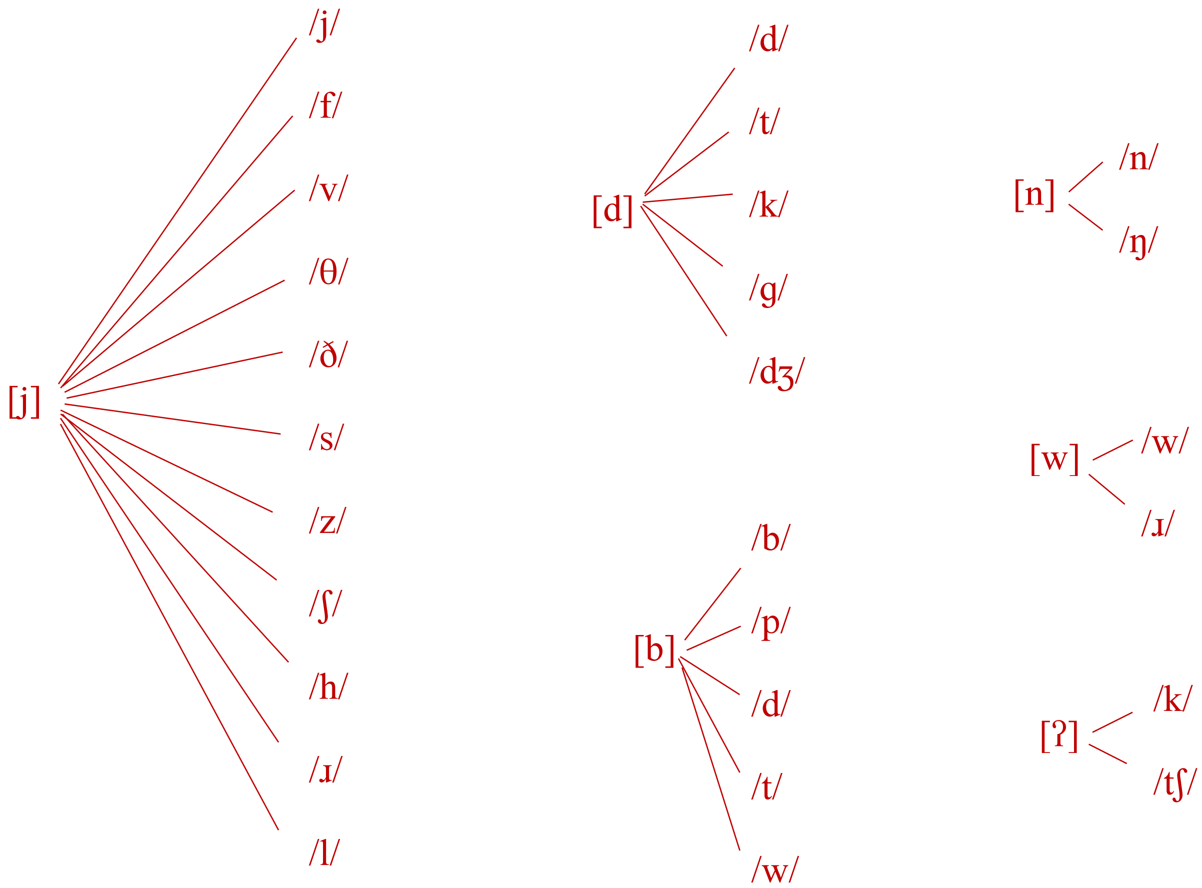
List phonetic level errors e.g., dentalisation, lateralisation: N/A

Patterns and Processes (with age of suppression if known, in parentheses (Grunwell, 1987) and highlighted in grey (Dodd et al., 2002)

Typical/Atypical Phonological Processes/Patterns (key to abbreviations can be found in Bates, Titterington and UK & Ireland CSDRN (2017))								
	Redup (2;0)	WSD (2;0-3;11)	FCD (2;0)	h-del	Cl. Red (2;0-4;11)	CH (4;0)	Voice (2;0-2;11)	Devoice (3;0)
	Pal front (3;9)	Vel front (2;0-3;11)	Stopping /f,s/=3;0, /v,z/=3;6	Stopping of Affric (4;6)	Glide approx. 5;0	Vocalisation of word final	l-voc (2;0)	Deaffric (2;0-4;11)

Tick or make a tally count for all patterns evident.			/ʃ,tʃ,dʒ/=4;6 /θ,ð/=5;0		/ɹ/ ≥ 6;0	/ɹ/ or /r/ (rhotic accents)		
	Diph Red	**Diphisation**	**Vowel lowering**	**Vowel raising**	**Vowel fronting**	**Vowel backing**	**Fricative Simp**	**Backing**
	Glottal replacement	**Lin. features**	**Glidefric**	**Systemic Phoneme Collapse**	**ICD**	**Coal. features**		
	Other:							
	Delay apparent (✓ /✗): ✓ **Range of delay apparent (i.e., 6-37 months):** 6-30 months **Atypical patterns apparent (✓ /✗):** ✓ **Youngest age of acquisition for phonemes with no PPK (never used correctly) (McLeod and Crowe 2018):** **Note any positional constraints e.g., velar fronting only in word initial position:** Fronting of /k/ resolving in word final position; managed /g/ in onset cluster reduction realisation for /gl/ but not when the singleton was targeted; one incidence of fricative use in one syllable position (/s/). Note variable treatment of fricatives which reflects phonotactic constraints i.e., gliding is only possible in syllable initial position. **List the key dominant and most consistent patterns (where available add age of suppression and note any that are atypical):** Cluster reduction (2;0-4;11), FCD (2;0) and gliding of fricatives (atypical)							
Systems of phoneme collapse for typical and atypical processes e.g.,	**Extensive phoneme collapse apparent (✓ /✗):** ✓ **Identify preferred substitution/s for the most prevalent patterns:**							





Variability	**Progressive variability (✔ / ✘):** ✔ **Context Conditioning (✔ / ✘):** ✘ **Widespread unexplained variability (✔ / ✘):** ✘

	Note any exceptions from general patterns for specific phonemes i.e., one example of stopping in a predominant pattern of gliding of fricatives: nothing to note **Supplementary assessment: Token-to-token variability/variability across multiple repetitions of the same word i.e., lexical inconsistency (✔/✘/N/A):** ✘		
Non-system-wide, word level errors	**Present (✔/✘):** ✔ **List types of errors i.e., metathesis, transposition, sequencing errors, vowel and/or consonant insertion:** Consonant Harmony, consonant insertion		
Connected Speech Patterns	**See separate analysis sheet**		
OVERALL INTELLIGIBILITY RATING/RATING OF IMPACT	**Assessment, date and findings i.e., Intelligibility in Context Scale (McLeod, Harrison et al. 2012):** awaiting results		
Oro-motor Examination (comment as appropriate) May map to standardised assessment scores	**Structure (ensure soft and hard palate are intact):** WNLs	**Function:** WNLs	**DDK rates:** WNLs
	Where differential diagnosis is required between possible CAS, dysarthria or articulation difficulties note observations of any abnormalities in strength, speed, range, steadiness, tone and/or accuracy of movements required for aspects of speech production including (Duffy 2013, p. 4): **Breathing** **Phonation** **Resonance** **Articulation** **Prosody**		
Phonological Awareness Skills Informal/Formal/Not applicable	Not yet assessed		

Speech/Auditory Discrimination Scores Informal/Formal/Not applicable	Not yet assessed
Standardised Scores on Phonological/Articulation Assessment (if applicable)	N/A
ALERTS/WARNING SIGNS FOR DISORDER/PERSISTENT SSD/CAS (circle/highlight all that apply)	
SSD alerts (circle all that apply)	***Characteristics of Phonological Disorder (Stoel-Gammon and Dunn 1985):*** • **Delayed development of phonological processes from early-on i.e., persistence of natural phonological processes which typically resolve by 2;0-2;6 years** • **Notable variability (non-progressive inexplicable variability (not progressive variability or context-conditioning)** • **Use of later acquired sounds alongside persistent errors of earlier acquired sounds** • **Atypical patterns** • **Limited contrastiveness** • **Speech sound system that has become fixed at an earlier stage of phonological development** ***Characteristics of Childhood Apraxia of Speech*** **Note key features which must be present for CAS diagnosis re ASHA (2007):** • **Inconsistency on multiple repetitions of probed words plus** • **Difficulty with co-articulatory transitions between segments and syllables** • **Prosody that is inappropriate e.g., marking typical lexical and phrasal stress patterns** ***Consider also features of Childhood Apraxia of Speech by Strand (Shriberg et al. (2012) table II, p. 453):*** • **"Vowel distortions (NB. These refer to phonetic errors such as abnormal vowel lengthening as opposed to systematic vowel error patterns such as vowel lowering or backing. The latter may be present but can also features of phonological disorder.)** • **Voicing errors**

	• **Distorted substitutions** • **Difficulty achieving initial articulatory configurations or transitionary movement gestures** • **Groping** • **Intrusive schwa** • **Increased difficulty with multisyllabic words** • **Syllable segregation** • **Slow rate** • **Slow diadochokinetic rates** • **Equal stress or lexical stress errors"** **A child must have vowel distortions and at least 3 of the other errors across 3 different types of speech task in order to be differentially diagnosed with CAS.** ***Additional alerts for persistent SSD from Bowen (2015):*** • **Glottal stops used when not dialectal (excessive and not explained by context-conditioning) (commonly associated with cleft palate/VPD, and also commonly reported as a characteristic of CAS by some sources *(Namasivayam et al. 2015)*** • **Initial consonant deletion (found typically in some languages)** • **Small phonetic inventory** • **Alveolar backing (particularly associated with OME and/or cleft palate/VPD)** • **Vowel errors (prevalent or inconsistent suggest CAS but can also be apparent in phonological disorder)** • **Persistent FCD when 3 years +** • **Conversational PCC < 50% at ~ 5;6 (Shriberg and Kwiatkowski 1982)** (Note was from SW sample – 24%)
CONSIDER ALL DATA AND ANALYSES IN LIGHT OF CHILD'S CHRONOLOGICAL AGE, AND INDEPTH CASE HISTORY INFORMATION TO SUPPORT DIAGNOSTIC THINKING	

• ***Alerts for speech sound disorder (Bowen 2015, box 2.2, p. 81):***
  • ***Late onset or no babbling***
  • ***Hearing history: Otitis media with effusion > referral for hearing screening***
  • ***Critical age hypothesis – need to be intelligible by 5;6 yrs re literacy etc.***
  • ***Developmental delay/Intellectual disability – SSDs more likely; deletion of Cs most frequent error; inconsistent errors; pattern of delay***
• ***Alerts for persistent SSD (Eadie et al. 2015, Wren et al. 2016):***	

• *Family history of SSD* • *Gender – being male* • *SES – lower SES* *Early Childhood:* • *Early feeding history - weak suck* • *Words not combined at 24 months* • *Limited use of morphology at 38 months* • *Unintelligible to strangers at 38 months* • *Speech and motor difficulties at 24 months sensitive to risk of SSD at 48 months* *School-age:* • *Hearing impairment at 7 years (> 20dBHL)* • *History of vent insertion up to 8 years* • *Parental report of difficulty with pronunciation at 7 years* • *Poor nonword repetition* • *Suspected difficulties with motor co-ordination*	
DIAGNOSIS AND SEVERITY (These classifications relate to primary SSD and are derived from Dodd (1995, 2005)) **Circle as appropriate**	**Phonological Delay (uses typical phonological processes but delayed for age)** **Consistent Phonological Disorder (systematic use of atypical/deviant patterns in addition to typical phonological processes)** **Articulation Disorder (phonetic level errors which may or may not result in a loss of contrast)** **Inconsistent Phonological Disorder (high degree of token-to-token variability without associated oro-motor deficits)** **Childhood Apraxia of Speech (see classification above)** **Dysarthria** **NB. Children may also present with a mixed profile.**

	Severity: **Mild** **Moderate** **Severe**

Key to phonological processes/patterns and atypical patterns:

Redup – reduplication; WSD – weak syllable deletion; FCD – final consonant deletion; h-Del - h-deletion; Cl. Red - cluster reduction; Diph Red - diphthong reduction; Diphisation – diphthongisation; Voice – voicing; Devoice – devoicing; Pal front - palatal fronting; Vel front - velar fronting; Stopping of Affric – stopping of affricates; Deaffric - deaffrication; Glide approx. – gliding of approximants; l-voc - l-vocalisation; VPD - Velopharyngeal dysfunction; Glottal replacement (if not dialectal and/or context appropriate); Backing - alveolar backing; Glidefric – gliding of fricatives; systemic phoneme collapse - systematic sound preference/phoneme collapse; ICD - initial consonant deletion; Coal. features - coalescence of features; Lin. features - linearization of features.

SOUTHERN BRITISH STANDARD	
VOWELS (SBS SYSTEM)	
PHONETIC INVENTORY (tick if phones are present at all in the child's system (even if used incorrectly))	
CORNER VOWELS	i ✓ a ✓ ɑ ✓ u ✓
MID-VOWELS	ɪ ✓ ɛ ✓ ɜ ✓ ə ✓ ʌ ✓ ɒ ✓ ɔ ✓ ʊ ✓
DIPHTHONGS	**Closing (rising from open to closed)** eɪ ✓ aɪ ✓ au ✓ ɔɪ ✓ əu ✓ **Centring (ending in schwa)** iə ✓ ɛə ✓ uə ✓
PRODUCTIVE PHONOLOGICAL KNOWLEDGE (circle phones used correctly at least once in the sample and highlight gaps)	
i a ɑ u ɪ ɛ ɜ ə ʌ ɒ ɔ ʊ eɪ aɪ au ɔɪ əu iə ɛə uə	
Optional: Percentage Vowels Correct (correct vowels/total vowels x 100 = %) = 100%	

SCOTTISH VOWELS	
PHONETIC INVENTORY (tick if phones are present at all in the child's system (even if used incorrectly))	
CORNER VOWELS	i a o
MID-VOWELS	ɪ e ɛ ə ʌ ʉ ɔ
DIPHTHONGS	**Closing (rising from open to closed)** ʌi ɑːe ʌʉ ɔə
PRODUCTIVE PHONOLOGICAL KNOWLEDGE (circle phones used correctly at least once in the sample and highlight gaps)	
i a o ɪ e ɛ ə ʌ ʉ ɔ ʌi ɑːe ʌʉ ɔə	
Optional: Percentage Vowels Correct (correct vowels/total vowels x 100 = %) =	

ULSTER VOWELS	
PHONETIC INVENTORY (tick if phones are present at all in the child's system (even if used incorrectly))	
CORNER VOWELS	i a ɑ/ ɒ ʉ
MID-VOWELS	ɪ ɛ ɜ ə ʌ ɔ o
DIPHTHONGS	**Closing (rising from open to closed)** **Centring (ending in schwa)**
PRODUCTIVE PHONOLOGICAL KNOWLEDGE (circle phones used correctly at least once in the sample and highlight gaps)	
i a ɑ ɒ ʉ ɪ ɛ ɜ ə ʌ ɔ o ɛə iə ʉə oə ɔə ai ei ɔi ɒʉ	
Optional: Percentage Vowels Correct (correct vowels/total vowels x 100 = %) =	

Monosyllables: CV, CVC

WORD STRUCTURE							
INVENTORY OF WORD STRUCTURES (tick structures present (even if not correct) and circle those that are only used correctly)							
Monosyllables	CV ✔	VC	CVC ✔	CCVC	CVCC	CCVCC	
Disyllables	CVCV ✔	CVCVC ✔	CCVCVC ✔	CVCCVC	CVCVCC	OTHER (provide structures):	
Multisyllables	CVCVCV ✔	CVCVCVC	CCVCVCV	CCVCVCVC	OTHER (provide structures): CVCVCVCC, CVCVCVCV, CVCCVCV		
Clusters Used	Initial Clusters consistent (✔/✘): ✘ Final Clusters consistent (✔/✘): ONE EVIDENT – [nt] Medial clusters: evidence of attempts to use more than one consonant within syllable boundaries but none of these are correct.						
Optional: Percentage word structure used correctly (correct word structure/total word structures x 100 = %) =							

Connected Speech Analysis and observation of prosody	
Circle/highlight if and as appropriate	
Greater use of patterns than noted at single word level	Yes No
Presence of open juncture:	3. Non-use of typical connected speech processes 4. Inappropriate use of pauses/glottal stops between words
Presence of close juncture:	3. Overuse of segmental/syllable elisions 4. Weakened articulatory realisations
Additional Prosodic disruptions	3. Lexical stress appropriate/not appropriate e.g., /ˈmʌmɪ/ > [ˈmʌˈmɪ] 4. Sentence level stress appropriate/not appropriate e.g., focus, attitude, grammar etc are expressed meaningfully.
Additional comments (further detail on observations as appropriate e.g., child is using syllable-timed speech): Not Tested	

Summary of information extracted using the PPSA / Checklist for Speech Analysis

Phonetic Inventories

Consonant singletons produced: [p, b, t, d, k, g, m, n, s, w, l, j, ʔ]

Consonant singletons never produced correctly (no PPK): /ŋ, **f, v, ɵ, ð, z, ʃ, h, tʃ, dʒ**, ɹ/

Consonant singletons not tested: /ʒ/

Consonant clusters produced: [-nt] in word final position and some attempts at sequencing consonants word medially.

Consonant clusters never produced correctly: [pɹ, bɹ, tɹ, kw, kɹ, gl, fɹ, ɵɹ, sp, sw, sn, sk, spl, stɹ, skw, -ts, -vz, -ndʒ]

Observations

- Limited inventory of singleton consonants, particularly word-finally; fricatives and affricates most compromised (1 token only of /s/)
- No word-initial clusters and only 1 homorganic word-final cluster produced correctly (but limited opportunities).
- Some attempts at word-medial consonant sequences but none of these are correct.
- Percent Consonants correct: singletons 24%, initial clusters 0%, final clusters 38% (but limited tokens)

Vowel inventory

- Complete

Word Structure inventory

Monosyllables: CV, CVC

Disyllables: CVCV, CVCCV, CVCVC

Multisyllables: CVCVCV, CVCVCVCC, CVCVCVCV, CVCCVCV

Observation

- Limited range of word structures exhibited (predominantly reflecting cluster reduction and final consonant deletion).

Processes/patterns

- Delayed natural phonological processes: reduplication, weak syllable deletion, final C deletion, cluster reduction, pre-vocalic voicing, velar fronting, stopping of affricates, gliding of liquids, glottal replacement, consonant harmony
- Atypical patterns: consonant insertion, gliding of fricatives (resulting in systemic phoneme collapse).
- No positional constraints. NB. variable treatment of fricatives across word positions reflects phonotactic constraints, i.e., the fact that glides only occur syllable-initially.

Variability in production

Some evidence of progressive change, i.e., final C deletion moving towards suppression: correct tokens achieved word-finally for /p, b, k, m, n, s/, glottal stop produced word-finally in place of /k/
Voicing contrast emerging word-finally among plosives
Exceptions from general patterns:- one instance of /t/ → [b] word-initially, 2 instances of /d/ → [b] word-medially, and 1 instance of /w/ → [b]. Looking back at the transcription data, these can all be explained in terms of consonant harmony.

NB. Sample insufficient to fully explore patterns.

Implications for diagnosis

Delayed suppression of phonological processes (e.g., pervasive final consonant deletion (FCD) at 5;6 years of age)

Limited contrastiveness i.e., systemic phoneme collapse due to pervasive FCD and severely limited consonant inventory

Atypical patterns (gliding of fricatives)

Variability in production reflects some progressive change or consonant harmony. Token-to-token variability, i.e., variability in production of individual words across different repetitions not yet tested.

DIAGNOSIS: Severe consistent phonological disorder

Implications for Intervention

A phonological approach to intervention is necessary.

Given the severe loss of contrast within Stanley's system, it is important to consider which intervention approaches will lead to the greatest amount of system-wide change in the least amount of time (see Bowen 2015, McLeod and Baker 2017, Storkel 2018a and 2018b, Williams *et al.* 2020 for review of different intervention approaches for SSD). Hegarty *et al's* (2018) online tool: SuSSD: Supporting and Understanding speech sound disorder - Ulster University may provide support on evidence-based clinical decision making for children with SSD focusing on the application of conventional minimal pairs (Weiner 1981), multiple oppositions (Williams 2010) and the complexity approach (e.g., Gierut 1989, 2005, Gierut and Champion 2001) to practice.

The clinical decision making for Stanley may involve use of one of the following approaches[6]

- Conventional minimal pairs (Weiner 1981): the child's segmental (or structural) phonological process/atypical pattern is contrasted with the target using sets of homonymous minimal pairs e.g., /jɒt/ versus /hɒt/ (where Stanley is substituting [j] for [h]), or /spaɪ/ versus /baɪ/ (where Stanley is reducing /sp/ → [b]). The selection of targets for this approach is dictated by the child's substitutions

[6] Notably there are alternative options, e.g., phonotactic therapy (Velleman 2002) - see Bowen (2015), McLeod and Baker (2017) and Williams *et al.* (2020) for a review of intervention approaches for phonological SSD.

for the adult target forms and is often influenced by the use of more traditional selection criteria e.g., use of stimulable sounds. This approach is most appropriate for children under 4 years of age and those who may not be able to cope with more challenging targets (Rvachew and Nowak 2002).

- Multiple oppositions (Williams 2000) - like conventional minimal pairs, this approach addresses the loss of meaning distinction resulting from reduced contrastiveness within the child's system. However, it is designed specially to target the loss in meaning that results from <u>systemic</u> phoneme collapse. It would therefore be highly appropriate for Stanley considering his extensive use of [j] for all fricatives and liquids word-initially. This approach also attempts to increase the complexity for the child by encouraging SLTs to select targets that are as different from the child's substitution as possible (considering both phonetic feature differences, i.e., voice, place and/or manner and major class distinctions i.e., obstruent vs sonorant). Thus, for Stanley, an appropriate stimuli set would contain minimal pairs contrasting /j/ with /f, ʃ, tʃ, h/.

- The three types of targets used within the complexity approach by Gierut and her colleagues (e.g., Gierut 1989, 2005, Gierut and Champion 2001) do not address homonymy (the collapse in meaning for the child resulting from their SSD) but rather aim to drive more rapid and system-wide change by focusing on targets beyond those more easily attainable by the child (i.e., later acquired, less stimulable, maximally differentiated pairs) triggering major reorganisation within the child's speech system. This approach is considered most suitable for children over 4 years of age and for those able to cope positively with the challenge of addressing areas of least PPK as opposed to building on success by consolidating emerging contrasts. It is recommended that SLTs wanting to use these approaches complete further reading/training as a support e.g., see Hegarty *et al's* (2018) online tool: SuSSD: Supporting and Understanding speech sound disorder - Ulster University, McLeod and Baker (2017, chapter 13), Storkel (2018a and b) and Williams *et al.* (2020, chapter 4). The types of targets used in the complexity approach are listed below in order of difficulty (with the first being the least demanding, and the last being the most demanding). The 2-/3-element clusters (the most demanding) targets aims to drive systemwide change most efficiently compared to the other two types of target. If 2-/3-element targets are felt to be too challenging for some children, there are still options to use the maximal oppositions or empty set approaches. It is also important to note that while we have used real word examples here, Gierut and her colleagues recommend using non-words to foster greater generalisability (while being mindful that it would not be appropriate to use non-words for children with semantic weaknesses). If choosing to use real words within the complexity approach, Storkel (2018a) outlines how certain word characteristics best support generalisation of learning and also provides further information on applying the complexity approach to practice (Storkel 2018b).

  For Stanley, the following targets would be appropriate:

  - Maximal oppositions – a sound not used is contrasted with a maximally different sound within the child's system e.g., /jɒt/ versus /ʃɒt/.
  - Empty set – two maximally different targets that Stanley has not yet acquired are worked on in minimal pair sets e.g., /wɪŋ/ versus /wɪʃ/. Note that in order to get maximally different contrasts for Stanley here, we have chosen to work on targets in word final position. Remember that in order for a contrast to be maximally different, sounds must differ in terms of voicing, place and manner of articulation and major class distinction, i.e., obstruent vs sonorant distinction.
  - 2-/3-element clusters – a cluster is targeted for Stanley that considers his cluster realisations and selects the most complex for him, avoiding any adjuncts (/st, sk, sp/), e.g., /fl/.

Further Investigation

- A stimulability assessment (this would be essential to support target selection).
- Further data elicitation/analysis to confirm patterns. NB. The current speech sample is very limited. For example, word-initial /k/ is only tested once and word-initial /g/ is not tested at all. Many of the fricatives have only been tested once in each word position.
- A connected speech assessment.

Summary note

Charting transcription data using a tool such as the PPSA clearly shows how many times a given phoneme has been tested across different word positions, highlighting where data is missing or limited and thus guiding further targeted probing. An understanding of the strengths and limitations of the speech sample is essential to be confident that the speech sample and subsequent analysis is representative of the child's abilities. For example, the sample should contain sufficient data to identify processes/patterns and explore variability. It should also include a margin of error for transcription inaccuracy (see Guidelines for the Transcription of Child Speech Samples in Clinical Practice and Research for advice regarding sampling).

A contrastive analysis also provides an overview of the child's system as a whole. It goes beyond a simple process analysis by highlighting the child's phonological *strengths* as well as weaknesses and identifying any progressive change within the system, i.e., phonological processes/patterns already moving towards suppression. This more detailed picture of the child's PPK facilitates choice of intervention approach and allows the clinician to make an informed selection of therapy targets using either traditional developmental criteria (i.e., greater PPK) or more complex criteria (i.e., less PPK). This is particularly important in moderate-to-severe cases such as Stanley's where there is a widespread loss of contrast and where greater system-wide gains may be made by taking a more complex approach. The speech analysis checklist can be a helpful tool synthesizing analysis of the child's speech with clinical thinking, case history information and risk factors for persistent speech sound disorder, supporting transparent clinical thinking and effective and efficient selection of targets and intervention approach. The checklist may be found useful for: students, newly qualified practitioners, peer review and more experienced clinicians when encountering children with particularly severe SSD.